

**REMARKS**

As an initial matter, counsel wish to express their thanks for the courtesies extended at the interview held with Examiner Liao and Bos on July 8, 2009.

During the interview, the rejections of record were discussed. Specifically, the prior art of record and the combination thereof was discussed in regards to the *prima facie* case of §103 obviousness alleged in the final Office Action. The examples and comparative examples in the specification and the unexpectedly superior results shown therein were also discussed.

The following remarks are consistent with the discussion at the interview.

In the present Amendment, claim 6 has been added to recite “wherein the final catalyst has a platinum content of 0.05 to 1.5 % by weight and a palladium content of 0.05 to 0.5 % by weight”. Support for the amount of palladium can be found at page 14, lines 13-16 and Table 1, page 33 of the present specification. Support for the amount of platinum can be found at page 9, lines 16-18 and Table 1, page 33 of the present specification.

Claim 5 is rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kimura, et al. (JP 2001-353444) (“Kimura”) in view of Haensel, et al. (U.S. Patent 2,818,394) (“Haensel”).

On page 2 of the Office Action, the Examiner asserts that Kimura teaches a catalyst used for desulfurization, wherein the catalyst composition contains a zirconium oxide, an alumina, a sulfate ingredient, palladium and optionally another metal such as platinum. See paragraphs [0001] and [0009]-[0010] of Kimura. The Examiner also asserts that a second metal, such as platinum, may be added at any stage before the calcination step, both simultaneously or separately from the palladium. See paragraph [0025] of Kimura. The Examiner further asserts

that since Kimura teaches the addition of platinum to the sulfated zirconia before the alumina addition as a viable possibility, the order of process steps as claimed is not found patentable, because generally a change in process step sequence is not found patentable over the prior art and allegedly gives rise to a *prima facie* case of obviousness.

In addition, on page 4 of the Office Action, the Examiner concedes that Kimura does not clearly disclose the calcination step between the metal loading steps. The Office Action relies on Haensel to teach the general preparation of platinum-containing catalysts, wherein the platinum-containing composite is prepared by commingling an oxide with a platinum-containing solution, drying and calcinating the deposit, and then further commingling the calcinated composite with a platinum solution and calcinating. See col. 1, lines 28-34 of Haensel. The Examiner asserts that Haensel teaches that calcination is important to fix the catalyst to the support, such that it would have been obvious to one of ordinary skill in the art to calcine the composition (of Kimura) after incorporating metal into the molded shape and also after the subsequent impregnation, because Haensel teaches that impregnating and calcinating in discrete steps creates a catalyst of higher activity. See col. 2, lines 50-52 of Haensel.

#### **There Is No Proper Motivation To Combine Haensel With Kimura**

Applicants respectfully submit that there is no teaching, suggestion, motivation, or other reason to add the second calcination step of Haensel to the procedure of Kimura, because Haensel's teachings are limited to platinum and a non-sulfated support.

First, Applicants respectfully assert that although Haensel does disclose the use of various supports, including that zirconia may be used, Haensel does not teach or suggest the use of sulfated zirconia.

Rather, Haensel prefer an alumina support. Haensel states that “[i]t has been found that alumina shows unexpected advantages for use as a supporting component for the low platinum concentrations, apparently due to some *peculiar* association of the alumina with the platinum. . .” See column 1, lines 66-69 of Haensel (emphasis added).

Moreover, Haensel does not report any deficiency in the use of alumina as a support, which suggests that Haensel is already optimized with respect to this aspect of their disclosure, so there is no motivation to substitute another support in Haensel’s method.

Although Haensel does propose that their method may be used with a list of possible supports, including zirconia, there is no suggestion that *sulfated* zirconia can be used. Moreover, a person of ordinary skill in the art reading Haensel would be discouraged from trying sulfated zirconia as a support, because there would be no reason to expect that the *peculiar* association which takes place between alumina (or perhaps zirconia) and platinum would also occur between *sulfated* zirconia and platinum.

Therefore, a person of ordinary skill in the art would not have been motivated to apply the teachings of Haensel to a sulfated zirconia support with a reasonable expectation of success.

Second, although Haensel may suggest a two-step method for supporting platinum, there is no suggestion in Haensel that the platinum supported in the second step could be substituted for palladium. Haensel teaches that “[p]latinum is a *very unique* metal and has *very unique catalytic activities* and also the problems of preparing a good platinum containing catalyst are

*very specific to platinum.*" See column 2, lines 50-52 of Haensel (emphasis added). Haensel teaches that the reason for depositing a second layer of platinum after the first calcination step is due to a peculiar trait of platinum crystal growth. Namely,

"if this calcined composite is further commingled or impregnated with a platinum-containing solution, it appears that the new platinum brought in with the platinum-containing solution does not tend to associate itself with the platinum already on the catalyst and increase the crystal size of the existing platinum, but it appears that the new platinum preferably associates itself with the alumina and begins its own new crystal structure",

which apparently creates more points of contact between the platinum and alumina. See column 3, lines 13-22 of Haensel.

In view of Haensel's teachings that platinum is a very unique metal, the motivation to add a second deposition step or calcination step is limited to platinum because of the peculiar associations of platinum with alumina (or perhaps zirconia) and previously deposited platinum. There is no teaching or suggestion in Haensel that this second deposition and second calcination step could be applied to palladium with a reasonable expectation of success to form more points of contact or a catalyst of higher activity.

The Examiner asserts that Kimura suggests that platinum and palladium are both precious metals and platinum group metals, and that Kimura suggests adding platinum and palladium in any order, which implies interchangeability of these metals. See page 4, first full paragraph, of the Office Action of November 13, 2008.

However, although platinum and palladium may be interchangeable for the purposes of Kimura's single-calcination-step method, Haensel's teachings show that these metals are not

likely interchangeable for the purpose of Haensel's second, post-calcination deposition and second calcination step, neither of which Kimura teaches or suggests.

Therefore, there is no teaching, suggestion, motivation or reason to combine the second deposition and calcination steps of Haensel with the process of Kimura. Certainly, the proposed combination of Kimura in view of Haensel does not render the presently claimed invention obvious.

#### **Supporting Platinum First Yields Unexpected Results**

As discussed above, the Office has not established a *prima facie* case of obviousness. However, even if a *prima facie* case of obviousness had been established here, which it has not, the presently claimed invention exhibits unexpectedly superior results which rebut any such *prima facie* case of obviousness and confirm the patentability of the claims.

Applicants respectfully submit that the order in which the process steps are performed is not obvious, because the order of the steps claimed provides unexpectedly superior results.

Specifically, experimental evidence in the disclosure establishes that the claimed order of metal deposition and order of calcination produces unexpected results over control experiments that are as close to or closer to the presently claimed invention than the closest prior art reference. Therefore, Applicants respectfully submit that such a showing of unexpected results rebuts any *prima facie* case of obviousness.

As a courtesy, for ease of comparison, Applicants include Table 1-1 below, which is a composite of excerpts of Tables 1 and 2 found on pages 33 and 34 of the specification. Table 1-2 is a composite of excerpts of Tables 3 and 4 found on pages 36 and 37 of the specification.

<u>Table 1-1</u>	Ex. 1	Comp. Ex. 3	Comp. Ex. 4	Comp. Ex. 5
Catalyst	A	I	J	K
Pt content (% by weight)	0.3	0.3	0.3	0.3
Pd content (% by weight)	0.5	0.5	0.5	0.5
Specific surface area (m <sup>2</sup> /g)	135	135	132	128
Pore volume (cc/g)	0.20	0.20	0.21	0.20
Sulfur content (% by weight)	2.8	2.5	2.2	2.7
Crush strength (kg/2 mm)	1.8	1.7	2.0	1.6

<u>Table 1-2</u>	C <sub>5</sub> isomer ratio (%)		S content (ppm by weight) 150 hours
	20 hours	150 hours	
Catalyst A (Example 1)	70	70	0
Catalyst I (Comparative Example 3)	65	47	5
Catalyst J (Comparative Example 4)	66	60	3
Catalyst K (Comparative Example 5)	67	58	3

A comparison between Example 1 (Catalyst A) and Comparative Example 3 (Catalyst I) of the present specification shows that supporting platinum before the first calcination step and then supporting palladium before the second calcination step yields unexpectedly superior results over supporting palladium first, calcination, and then supporting platinum. Comparative Example 3 (Catalyst I) supports palladium before the first calcination step, then supports platinum on the support before the second calcination step. See pages 28 and 29 of the specification for the procedure. In contrast, Example 1 (Catalyst A) supports platinum before the first calcination step, then supports palladium before the second calcination step. See pages 22 and 23 of the specification for this inventive procedure. Looking at Table 1-1 above (pages 33 and 34 of the specification), it can be seen that Example 1 (Catalyst A) and Comparative Example 3 (Catalyst I) have identical amounts of platinum, palladium, specific area and pore volume. Looking to a comparison between these samples in Table 1-2 (pages 36 and 37 of the present specification), catalyst A yields a C<sub>5</sub> isomer ratio of 70% after 150 hours with 0% ppm sulfur content, whereas catalyst I has a 47% C<sub>5</sub> isomer ratio after 150 hours and a sulfur content of 5 ppm.

In contrast to these results, Kimura teaches that “these metals [i.e. Pt] may be introduced before the calcination and stabilization step. Of course, they may also be introduced simultaneously with palladium.” See paragraph [0025] of Kimura. Such a broad sweeping statement by Kimura that does not express any preference for loading order, as if the order of introduction of one or more metals were arbitrary and insignificant, indicates that a person of ordinary skill in the art at the time of the invention did not expect that the claimed order of

supporting platinum and then palladium would produce such unexpectedly superior results as those discussed above.

Moreover, Applicants point out in the disclosure how unexpected these results were at the time of the invention. Namely, Applicants state:

"by conducting the procedure of first preparing a platinum-supported sulfated zirconia-alumina and then supporting palladium, a catalyst capable of achieving desulfurization and isomerization *simultaneously* is obtained. *The reason for this fact is not clear. . .*" See page 17, lines 17-21 of the specification (emphasis added).

From the above statement and the following discussion, it is clear that the time of the invention, a person of ordinary skill in the art would not have expected such unexpectedly superior results from the claimed method.

Therefore, Applicants respectfully submit that the order in which the metals are loaded in the presently claimed invention yields unexpectedly superior results that are not taught or suggested by the cited references.

Moreover, as shown by a comparison of Example 1 (Catalyst A) against Comparative Examples J and K, it is clear that the presently claimed invention yields unexpected results because of the specific sequence for supporting metals followed by separate calcination steps to form a catalyst. In Comparative Example 4 (Catalyst J), palladium and platinum are both added in a single step and then calcinated. See page 29, line 23 through page 31, line 3 of the specification. In Comparative Example 5 (Catalyst K), the support is molded and calcinated with palladium and platinum added after calcination. Looking at a comparison between Example 1 (Catalyst A) and Comparative Examples J and K in Table 1-1 above (page 33 and 34), it can be

seen that Example 1 (Catalyst A) and Comparative Examples J and K have nearly identical amounts of platinum, palladium, specific area and pore volume. Yet, looking at Table 1-2 above (pages 36 and 37), the C<sub>5</sub> isomer ratio decreases for Comparative Examples J and K by 10 and 12 %, respectively, while the S content increases by 3 ppm after 150 hours of use. This evidence clearly demonstrates that a calcination step after supporting each metal is important to obtaining a catalyst having unexpectedly superior properties.

In direct contrast to these results, Kimura teaches that “[i]t does not matter whether the above calcination/ stabilization treatment is conducted before or after a metal such as palladium or the like is deposited.” See paragraph [0032] of Kimura. Such a statement by Kimura indicates that a person of ordinary skill in the art at the time of the invention did not appreciate or expect that adding a calcination step after each metal is supported could yield such unexpectedly superior results as those demonstrated by the presently claimed invention.

Moreover, Kimura do not appear to evaluate their catalyst for isomerization activity. Instead, Kimura only evaluate their catalyst for desulfurization activity. This lack of appreciation by Kimura of the isomerization activity displayed by a catalyst produced by the presently claimed invention indicates that the isomerization properties of the presently claimed invention may also be an unexpectedly superior result.

Next, the Examiner stated on page 5 of the Office Action of November 13, 2008 that “the unexpected results were found in an *intended use of the catalyst* being made, which does not bear much weight pertaining to the *method of making* the catalyst.” In response, Applicants respectfully submit that a showing of unexpected properties of a product, such as a catalyst, is exactly the sort of unexpected results which may rebut a *prima facie* case of obviousness,

regardless of the use of the product. Moreover, Applicants submit that a person of ordinary skill in the art is familiar with chemical analysis and will understand that chemicals, such as starting materials for a reaction, can be used to indicate an underlying structural difference in a product. Specifically, if catalysis is performed under substantially the same conditions, but using comparable catalysts prepared by different methods, than a change in catalytic activity must correlate to a corresponding change in the catalyst produced by the different method. Thus, Applicants respectfully submit that the change in catalysis shown above indicates that the claimed method for producing a catalyst does result in an unexpectedly superior product, as shown by improved catalytic activity.

Thus, Applicants have demonstrated that unexpectedly superior results have been obtained through both the claimed order of supporting platinum and then palladium on a support and through the addition of a calcination step after each metal is deposited on the support.

Further, Mr. Takahito Kawakami, an inventor of present application, submits herewith a Declaration Under 37 C.F.R. § 1.132. In the Declaration, Mr. Kawakami confirms that the catalyst produced by the claimed method does exhibit unexpectedly superior results. Also, based on subsequent research, Mr. Kawakami explains the underlying differences in the catalyst produced by the claimed method that account for the unexpectedly results, referring to an article entitled: Simultaneous isomerization and desulfurization of sulfur-containing light naphtha over metal/SO<sub>4</sub><sup>2-</sup>/ZrO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> catalyst Applied Catalysis A: General 276 (2004), pgs. 145-153. Also, Mr. Kawakami explains the practical significance of the claimed method of producing a catalyst.

In view of this evidence, Applicants respectfully submit that the presently claimed invention is not rendered obvious by the cited references because the recited order of depositing the platinum and palladium and calcination after each deposition step yields unexpected results.

**Catalysts Produced By The Claimed Method Demonstrate Unexpectedly Superior Results  
Based On The Amount of Platinum and Palladium Supported**

To the extent there may be any lingering doubt concerning patentability--although there should not be--Applicants have added claim 6 to recite a specific range of platinum and palladium that even further demonstrates unexpectedly superior results. Specifically, the C<sub>5</sub> isomer ratio has been shown to increase by 5% after 150 hours of catalysis when comparing catalyst D (containing 2.5% of palladium) to catalyst A (containing 0.5% palladium), where catalyst D is outside the scope of the presently claimed invention. See Tables 1 and 3 on pages 33 and 36, respectively, of the specification. Similarly, the C<sub>5</sub> isomer ratio increased 6% and the S content decreased by 1 ppm in going from catalyst E (2.5 % platinum) to catalyst A (0.3 % platinum), where catalyst E is outside the scope of the presently claimed invention.

Further, the C<sub>5</sub> ratio has been shown to increase by 5% after 150 hours of catalysis when comparing catalyst E (2.5 % platinum) to catalyst C (1.5 % platinum), where catalyst E is outside the scope of the presently claimed invention.

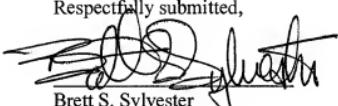
Based on these results, it is clear that the procedure for producing a catalyst for hydrodesulfurization and isomerization having a platinum content of 0.05% to 1.5% and a palladium content of 0.05% to 0.5% demonstrates unexpectedly superior results over the same procedure, where higher amounts of palladium or platinum are supported to form a catalyst.

In view of the above, Applicants respectfully submit that the presently claimed invention demonstrates unexpectedly superior results that are commensurate with the scope of the claims. Therefore, the claim 6 is not rendered obvious by any combination of the cited references.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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